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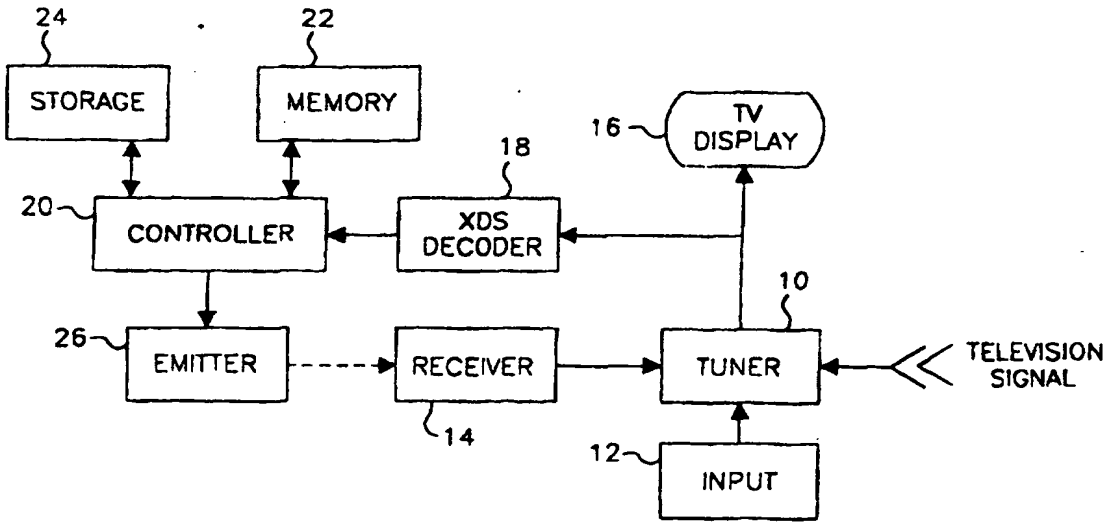

(57) Abstract

A television tuner (10) controller has a memory (22) with a number of sets of remote control codes for use in controlling a television tuner (10), such as a cable box. The television tuner changes the channel it is tuning to a specific channel when it receives a set channel remote control command identifying the specific channel. The tuner (10) controller can detect the channel tuned by the television tuner (10) whenever the predetermined base channel is tuned by the television receiver (14).

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ALTERNATIVE METHOD OF AUTOMATIC CABLE BOX SET

BACKGROUND OF THE INVENTION

The present invention relates to the automatic programming of a control device to enable the control device to remotely control another device through infrared signals.

As televisions, video cassette recorders, and other household devices have become more and more common, the number which can be controlled remotely has also increased. Many of these devices use an infrared signal emitter (in combination with a receiver connected to the device itself) as the "remote control." Typically, the manufacturers of the device have included such a remote control with the device. Naturally, the manufacturer's remote control has been capable of controlling its associated device. However, because different manufacturers use different infrared code sets, one manufacturer's remote control typically cannot control another manufacturer's device. As the number of remotely controllable devices in a user's household has increased, so has the number of remote controls. Many users have found this to be objectionable and sometimes confusing.

One solution offered to this problem has been the "universal remote." A universal remote is a device capable of remotely controlling multiple devices by using multiple infrared code sets. One common example is a remote control which can remotely control a television as well as a video cassette recorder. Universal remotes achieve this functionality by being programmable. The user can input various number codes to select which infrared code sets the remote control will use in controlling the devices.

Programming universal remotes is often confusing and many users have found this to be a difficult task. A simpler and more automatic method of determining the correct infrared code set would be an improvement in the art.

SUMMARY OF THE INVENTION

An embodiment of the present invention is a method for programming a control device for selection, from a plurality of infrared (IR) code sets, an IR code set for subsequent control of IR signal communication with a video device such as a video cassette recorder (VCR). In the case where the video device is a VCR, each IR code set is for communicating with a different corresponding VCR. To this end, each such VCR has a tuner, which, when tuned to an actual channel of broadcast video signals, provides video signals derived from the actual channel to a video output thereof. A predetermined series of signals is provided to the VCR using a selected IR code set, which is selected from one of the provided IR code sets. The video output of the VCR is monitored for predetermined signal conditions. An IR code set is then selected for subsequent signal communication with the VCR. The IR code set which is selected is the one

which results in the predetermined signal conditions. With this arrangement, it is possible to automatically determine the proper IR code set for communication between a remote controller and any of a number of VCRs automatically with virtually no user intervention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a system according to an embodiment of the invention;

FIG. 2 is a flow diagram illustrating a method according to an embodiment of the invention;

FIG. 3 is a truth table illustrating the logical analysis employed by an embodiment of the invention.

DETAILED DESCRIPTION

The present invention describes a system for automatically selecting one IR code set which is appropriate for remotely controlling a particular video device, such as a cable box, from a plurality of IR code sets stored in, for example, a VCR. The system sends a series of commands to the particular video device using a selected test IR code set and monitors the results of those commands by examining the video signal coming from the video device. These results are analyzed to determine if the test IR code set successfully controls the video device. If the test IR code set does not successfully control the video device, then the system cycles through all of the stored IR code sets as the test IR code set until an IR code set which successfully controls the video device is found.

FIG. 1 depicts one embodiment of the present invention where a tuner 10 receives television signals from an outside source and outputs a video signal derived from the television signals on the channel to which the tuner 10 is set. The tuner 10 can be set either manually by the user via input 12 or remotely via a receiver 14. The video signal goes to a television display 16 and also to a XDS decoder 18.

XDS signals are transmitted by the broadcasting source in the vertical blanking interval (VBI) portion of the video signal and contain digital information, including information about the video signal in which they are contained. The XDS decoder 18 filters the video signal from the tuner 10 so that an XDS signal is isolated, if present. By analyzing the XDS signal, the XDS decoder 18 can derive various information about the video signal such as the channel number or other channel identifier for the channel to which the tuner 10 is set. In alternative embodiments, VBI decoders that look at a different portions of the VBI for data signals other than XDS signals are used. In any case, the VBI decoder is set to decode a portion of the video signal from which the channel number or channel identifier for the channel to which the tuner 10 is set can be derived. Other embodiments may be employed that do not use a VBI decoder, as long the

controller 20 is able to receive information identifying the channel to which the tuner 10 is tuned at a particular time.

The XDS decoder 18 sends the XDS signal information to a controller 20. The controller 20 is connected to memory 22 in which it can store XDS signal information, comparison results, or any other information. The controller 20 is also connected to storage 24 from which it can access previously stored IR code sets. Storage 24 can be any data storage device, but preferably is a ROM or other non-volatile memory. Using an IR code set from the storage 24, the controller can cause an emitter 26 to send appropriate IR signals to the receiver 14 in order to remotely control the tuner 10. Using a process described below, the controller 20 sends several commands to the tuner 10 and stores the results in the memory 22. After storing various XDS signals and comparison results in the memory 22, the controller analyzes this information to determine whether the current IR code set is the IR code set which is the correct set to remotely control the tuner 10. This allows the controller to automatically select the correct IR code set for remotely controlling the tuner 10.

In an embodiment such as the one described above and in FIG. 1, the system can determine the correct IR code set for remote control of the video device using a series of operations such as those described below and shown in FIG. 2.

First, in block 100, the user manually inputs a predetermined channel into the tuner 10 via the input 12. This channel is the "Base Channel." The Base Channel must be a channel which is identifiable by the controller, such as one which contains an XDS signal in the VBI. The channel for the Public Broadcast Station (PBS) in the user's area is a preferred choice for the Base Channel because PBS stations presently broadcast an XDS signal in the VBI throughout the country.

In block 110, the controller then retrieves the first test IR code set to test from the storage 24. Using the XDS decoder 18, in block 105, the controller 20 then determines the XDS signal information of the current video signal, which is the Base Channel, and stores the information in the memory 22. This is the "Base Signal." The controller then sends, in block 115, via the emitter 26, to the receiver 14, an IR signal which is appropriate to the current test IR code set to set the channel of the tuner 10 to some predetermined channel. This predetermined channel is the "Test Channel."

Also in block 115, using the XDS decoder 18, the controller 20 determines the XDS signal information of the current channel and stores this in the memory 22. This result is "Test1." The controller 20 compares Test1 to the Base Signal. If they are different, meaning the channel of the tuner 10 was successfully changed, then the current IR code set is the correct set. If Test1 and the Base Signal are the same as is discussed in more detail below, the analysis must continue. The result of the comparison of Test1 to the Base Signal is stored in the memory 22.

The controller 20, in block 120, then sends via the emitter 26 to the receiver 14 an IR signal appropriate to the current IR code set to increment the channel of the tuner 10. Using the XDS decoder 18, the controller 20 determines the XDS signal information of the current channel and stores the information in the memory 22. This result is "Test2." The controller 20 then compares Test2 to the Base Signal and stores the result of this comparison in the memory 22. This result is "Result2." Similar to Result1 and as discussed below, Result2 is not determinative of whether the current test IR code set is the correct code set, either.

Next, in block 125, the controller 20 then sends via the emitter 26 to the receiver 14 an IR signal appropriate to the current IR code set to again set the channel of the tuner 10 to the Test Channel. Using the XDS decoder 18, the controller 20 determines the XDS signal information of the current channel and stores this in the memory 22. This result is "Test3." The controller 20 then compares Test3 to the Base Signal and stores the result in the memory 22. This result is "Result3." Now, the combination of Result1, Result2 and Result3, as explained below, is determinative of whether the current test IR code set is the correct code set.

In block 130, the controller analyzes the results of the three comparisons, between Test1 and the Base Signal (Result1), Test2 and the Base Signal (Result2), and Test3 and the Base Signal (Result3). As described below and shown in the FIG. 3, if Test1 is different from the Base Signal, the current IR code set is the correct set and the analysis is complete. In this case, the Yes path from block 135 is taken and the process is complete in block 140. If Test1 and the Base Signal are the same, the analysis must continue. If Test2 and the Base Signal are different and Test3 and the Base Signal are the same, then the current IR code set is the correct set and the process is complete. Again, in this case, the Yes path from block 135 is taken and the process is complete in block 140. Any other combination of results indicates that the current IR code set is not the correct IR code set.

After completing this analysis, if the current IR code set is not correct, the No path from block 135 is taken. But first, the controller 20 will reset the tuner 10 to the Base Channel if necessary. If the tuner 10 was successfully incremented but the IR code set was not correct (CASE 3 or CASE 6 in FIG. 3), then the tuner 10 is set to some channel other than the Base Channel. To set the tuner 10 to the Base Channel the controller 20 sends via the emitter 26 to the receiver 14 an IR signal which will decrement the channel to which the tuner 10 is set. This will return the tuner 10 to the Base Channel.

The No path from block 135 is then taken and the controller 20 will return to block 110 and select the next IR code set from the storage 24. The controller 20 will then begin the process again by using the XDS decoder 18 to determine the XDS of the current channel, now the Base Channel once again, and store this in the memory 22 as the Base Signal. The process continues

from that point as before, storing Test1, Test2, Test3, Result1, Result2, and Result3 to determine if the new IR code set is the correct IR code set.

FIG. 3 depicts a Truth Table showing the logical analysis used in the present invention. In order to determine whether the current IR code set is the correct IR code set, all three commands (SET CHANNEL - CHANNEL UP - SET CHANNEL) are necessary. One command is insufficient because there are several unknown variables. In particular, some television tuners will respond correctly to the same channel up commands, but will not respond to the same set channel commands. When the user sets the channel of the tuner 10 to the Base Channel, the local channel number for the Base Channel may be the same as the predetermined Test Channel. If the result of a single command to set the channel of the tuner 10 to the Test Channel were relied upon, the incorrect IR code set might be selected. The channel input by the user, the Base Channel, might be the same as the Test Channel, giving the illusion that the command to set the channel of the tuner 10 was successful.

In addition, even if the current IR code set is not the correct IR code set, there may be some overlap between this incorrect IR code set and the video device's correct IR code set. This is because some IR code sets use the same IR code to indicate the signal for "channel up" (the command which increments the channel to which the tuner is set by one) and also for "channel down," even though other codes do not correspond. As a result, sending the a "channel up" signal to the tuner may not be conclusive. The IR code set may not be the correct IR code set for the VCR, but the "channel up" signal may be the same and the channel will be incremented. By using both commands, the "set channel" command and the "channel up" command, a unique and determinative result can be achieved.

In the complete logical analysis, there are six possible situations, as shown in FIG. 3. CASE 1 is where the Base Channel and the Test Channel are the same and the IR code set is the correct IR code set. CASE 2 is where the Base Channel and the Test Channel are the same, but the IR code set is incorrect for the video device and none of the commands are functional. CASE 3 is where the Base Channel and the Test Channel are the same, the IR code set is incorrect, but the "channel up" command is still functional. CASE 4 is where the Base Channel and the Test Channel are different and the IR code set is the correct IR code set. CASE 5 is where the Base Channel and the Test Channel are different, the IR code set is incorrect for the video device and none of the commands are functional. CASE 6 is where the Base Channel and the Test Channel are different, the IR code set is incorrect, but the "channel up" command is still functional. By using a series of commands the two cases where the IR code set is correct for this video device (CASE 1 and CASE 4) can be determined.

After sending the signal to set the tuner 10 to the Test Channel and determining the channel of the tuner 10 did not change, it is unknown if the channel did not change because the

IR code set is incorrect or because, though the IR code set is correct, the Test Channel and the Base Channel are the same. If the channel did change after sending the signal to set the channel to the Test Channel, then the analysis is complete. The only possibility is that this is CASE 4, where the Base Channel and the Test Channel are different and the IR code set is correct. Now five possibilities remain, CASE 1, CASE 2, CASE 3, CASE 5 and CASE 6. After sending the "channel up" signal and comparing the XDS signal information to the Base Signal, if the channel was successfully changed, CASE 2 and CASE 5 are eliminated. However, there is no distinction between CASE 1, CASE 3 and CASE 6. The final step is to send the signal to set the channel to the Test Channel again. If the channel of the tuner 10 is successfully set to the Test Channel and the channel of the tuner 10 was previously successfully incremented, that is Test2 and the Base Signal were different and Test3 and the Base Signal were the same, then the current IR code set is the correct set for this video device.

The results of each of these comparisons, Test1 to Base Signal, Test2 to Base Signal, Test3 to Base Signal (also stored as Result1, Result2, Result3), are necessary, except in CASE 4. In CASE 2 and CASE 5, the channel of the tuner 10 will never change because the IR code set is completely incompatible with the video device. As a result, the comparison of Test1 to the Base Signal will indicate that they are the same and the comparison of Test3 to the Base Signal will indicated that they are the same. To distinguish CASE 2 and CASE 5 from CASE 1, the comparison of Test2 to the Base Signal is necessary. In CASE 1, Test2 and the Base Signal are different, while in CASE 2 and CASE 5, Test2 and the Base Signal are the same. Similarly, CASE 1, CASE 3, and CASE 6 have the same results from the first two tests (Test1 and the Base Signal are the same, Test2 and Base Signal are different). To distinguish CASE 1, a final "set channel" command is necessary. In CASE 1, the channel will be successfully returned to the Base Channel (Test3 is the same as Base Signal), while in CASE 3 and CASE 6, the channel will not change (so Test3 remains different from Base Signal) because the "set channel" command does not work. These comparisons allow the identification of the correct IR code set.

The embodiment and process described are only one example of how the logical analysis described can be used to determine the correct IR code set. Variations on this embodiment are possible so long as they utilize the same logical analysis of a combination of commands to isolate the correct IR code set.

What is claimed is:

1. A system comprising:

a television tuner for tuning one channel from an input of a plurality of channels comprising a remote control receiver responsive to a set channel command for changing the channel tuned by the tuner to a channel specified in the set channel command and a channel increment command for changing the channel tuned by the tuner to a next channel in order from the channel tuned by the tuner when the channel increment command is received by the remote control receiver; and

a tuner controller comprising:

means for detecting the channel tuned by the television tuner when at least a predetermined base channel is tuned by the television tuner;

a remote control transmitter for transmitting set channel commands and channel increment commands to the television tuner; and

automated code testing means comprising:

automated transmission means for automatically executing functions in sequence, the functions comprising: (1) transmitting a set channel command for a predetermined channel to the tuner, (2) first function of detecting whether the channel tuned by the television receiver is the base channel, (3) transmitting a channel increment command to the tuner, (4) second function of detecting whether the channel tuned by the television receiver is the base channel, (5) retransmitting the set channel command for the predetermined channel to the tuner, and (6) third function of detecting whether the channel tuned by the television receiver is the base channel.

2. The system of claim 1 wherein the tuner controller further comprises a memory storing a plurality of sets of remote control codes for controlling television tuners and the automated code testing means comprises means for operating the automated transmission means repeatedly for each of a plurality of the plurality of sets of remote control codes stored in the memory,

3. The system of claim 2 wherein the automated code testing means further comprises:

analyzing means comprising:

detecting means for detecting the occurrence of a first condition wherein the first function of detecting does not detect that the base channel is tuned by the television tuner and a second condition wherein the first function of detecting detects that the base channel is tuned by the television tuner, the second function of detecting does not detect that the base

channel is tuned by the television tuner and the third function of detecting detects that the base channel is tuned by the television tuner; and

halt testing means for ceasing the operation of the automated transmission means when the detecting means detects the occurrence of either the first condition or the second condition.

4. The system of claim 3 wherein the tuner controller further comprises means for storing in the memory an identification of the set of remote control codes used by the automatic transmission means when the halt testing means ceases the operation of the automated transmission means.

5. The system of claims 1-4 wherein the television tuner is comprised in one of the group of: a cable box, a satellite receiver, a wireless cable box, a television receiver and a video recorder.

6. The system of claim 1-4 wherein the tuner controller is comprised in one of the group of: a cable box, a satellite receiver, a wireless cable box, a television receiver, a video recorder and a hand held remote control..

7. The system of claims 1-6 wherein the means for detecting the channel tuned comprises a vertical blanking interval (VBI) decoder.

8. The system of claims 1-6 wherein the means for detecting the channel tuned comprises an Extended Data Service (XDS) decoder.

9. In a system comprising a television tuner for tuning one channel from an input of a plurality of channels comprising a remote control receiver responsive to a set channel command for changing the channel tuned by the tuner to a channel specified in the set channel command and a channel increment command for changing the channel tuned by the tuner to a next channel in order from the channel tuned by the tuner when the channel increment command is received by the remote control receiver; and a tuner controller comprising means for detecting the channel tuned by the television tuner when at least a predetermined base channel is tuned by the television tuner; and a remote control transmitter for transmitting set channel commands and channel increment commands to the television tuner the method comprising the step of:

(a) automatically executing, in sequence, the steps of :

(a1) transmitting a set channel command for a predetermined channel to the tuner,

(a2) detecting whether the channel tuned by the television receiver is the base channel,

(a3) transmitting a channel increment command to the tuner,

(a4) detecting whether the channel tuned by the television receiver is the base channel,

(a5) retransmitting the set channel command for the predetermined channel to the tuner, and

(a6) detecting whether the channel tuned by the television receiver is the base channel.

10. The method of claim 9 wherein the tuner controller of the system further comprises a memory storing a plurality of sets of remote control codes for controlling television tuners and the method further comprises the step of:

(b) performing the step of automatically executing (a) repeatedly for each of a plurality of the plurality of sets of remote control codes stored in the memory,

11. The method of claim 10 wherein the step of automatically executing further comprises, after the third step (a6) of detecting, the steps of:

(a7) detecting the occurrence of a first condition wherein the first step of detecting (a2) does not detect that the base channel is tuned by the television tuner and a second condition wherein the first step of detecting (a2) detects that the base channel is tuned by the television tuner, the second step of detecting (a4) does not detect that the base channel is tuned by the television tuner and the third step of detecting (a6) detects that the base channel is tuned by the television tuner; and

(a8) ceasing the performing of step (b) when the occurrence of either the first condition or the second condition is detected in step (a7).

12. The method of claim 11 further comprising the step of storing, in the memory, an identification of the set of remote control codes used in step (a) when the performance of step (b) is ceased.

13. The method of claims 9-12 wherein the television tuner is comprised in one of the group of: a cable box, a satellite receiver, a wireless cable box, a television receiver and a video recorder.

14. The system of claim 9-12 wherein the tuner controller is comprised in one of the group of: a cable box, a satellite receiver, a wireless cable box, a television receiver, a video recorder and a handheld remote control..

15. The system of claims 9-14 wherein the means for detecting the channel tuned comprises a vertical blanking interval (VBI) decoder.

16. The system of claims 9-14 wherein the means for detecting the channel tuned comprises an Extended Data Service (XDS) decoder.

FIG. 1

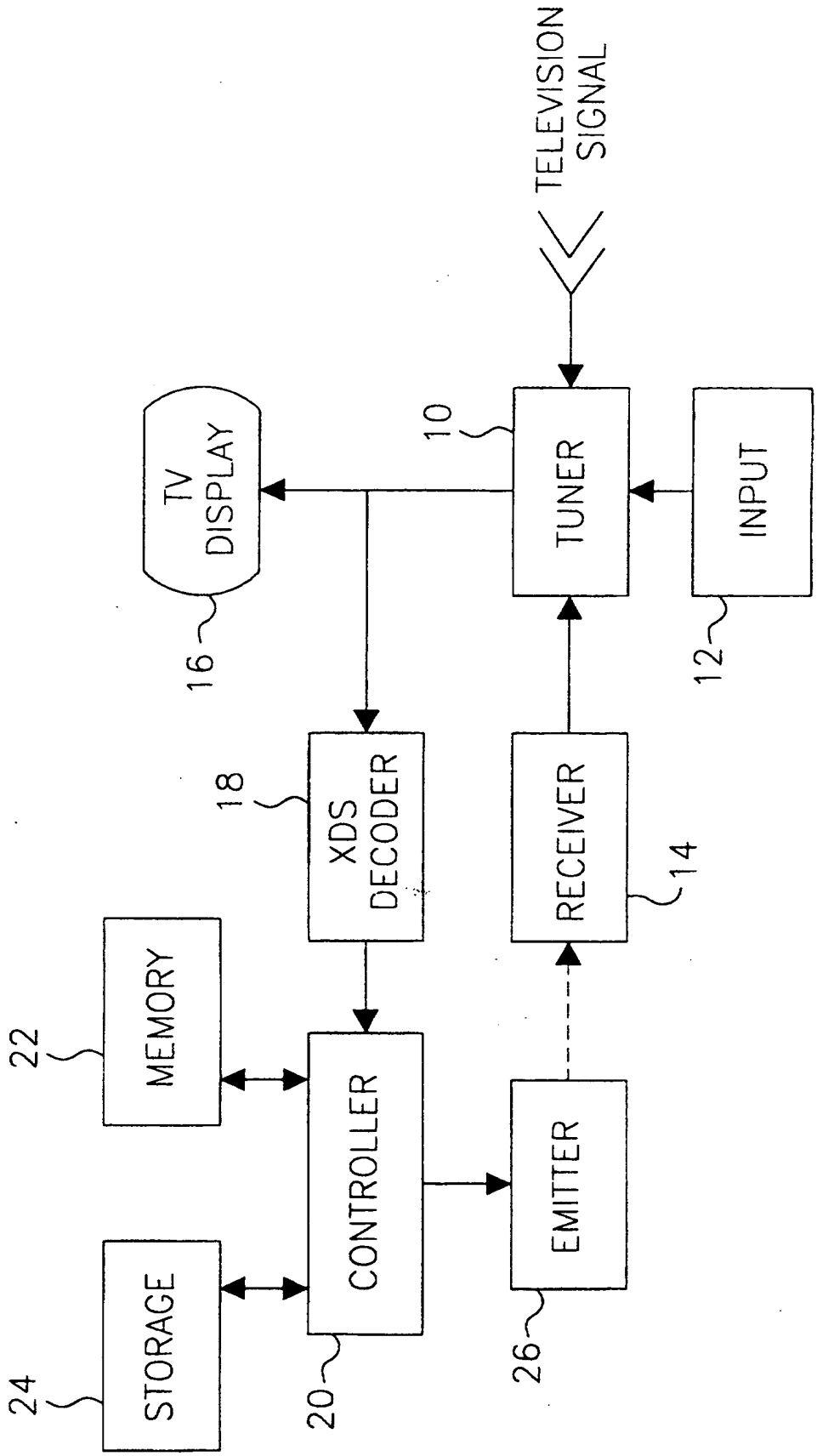
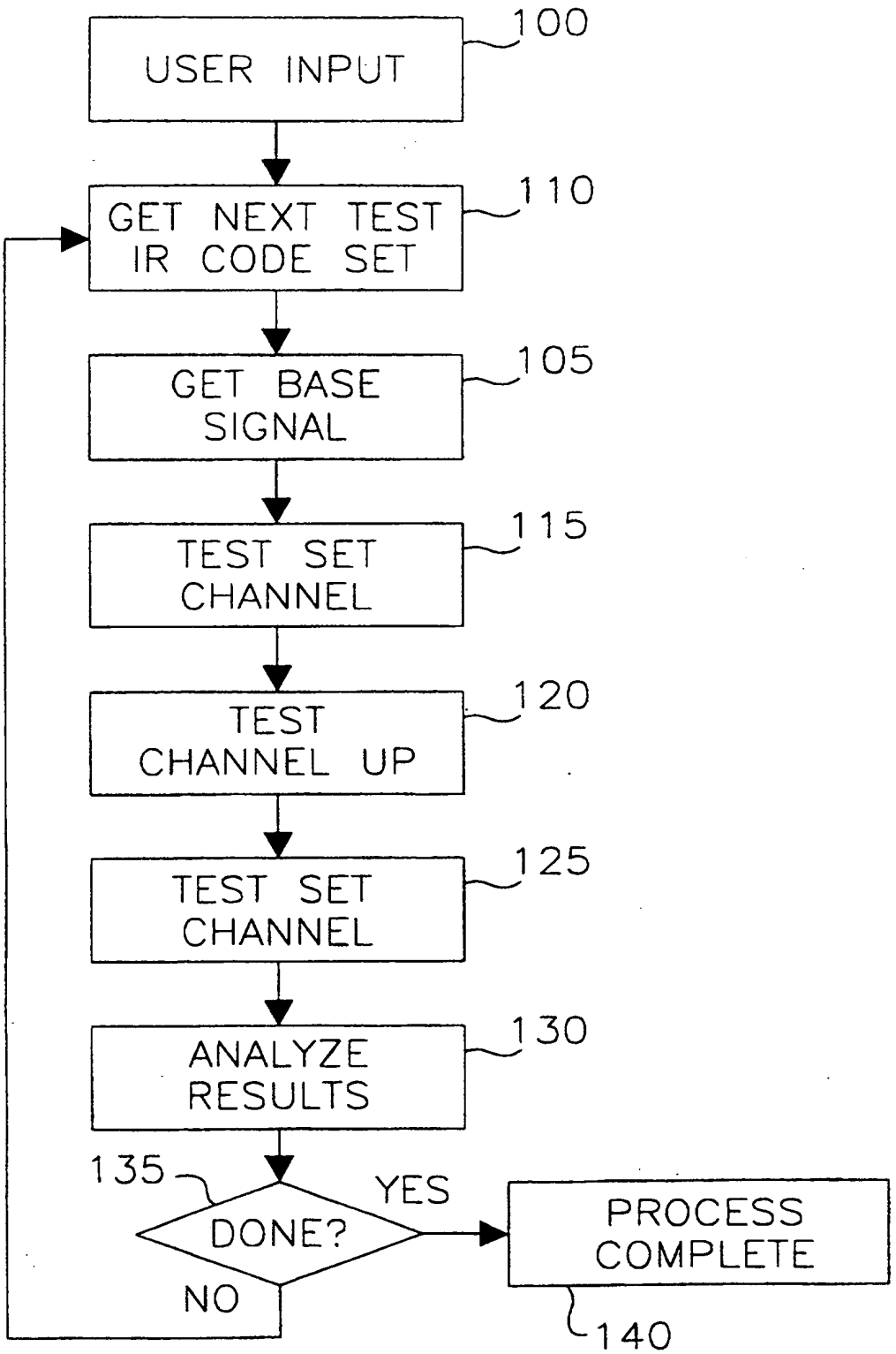


FIG. 2



TRUTH TABLE

	BASE CHANNEL = TEST CHANNEL			BASE CHANNEL ≠ TEST CHANNEL		
	IRC CORRECT	IRC INCORRECT		IRC CORRECT	IRC INCORRECT	
		CHANNEL UP WORKS	CHANNEL UP DOES NOT WORK		CHANNEL UP WORKS	CHANNEL UP DOES NOT WORK
	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5	CASE 6
END TEST CHANNEL	1	1	1	0	1	1
SEND CHANNEL UP	0	1	0	X	1	0
SEND TEST CHANNEL	1	1	0	X	1	0

Where "1" indicates that the channel to which the tuner is set after the command has been sent is the BaseChannel (indicated by the XDS signal information of the current video signal matching the XDS signal information of the BaseChannel, the Base Signal); "0" indicates that the channel after the command is not the BaseChannel; and "X" indicates an undefined result.

"IRC" stands for "Infrared Code set."

"SEND TEST CHANNEL" indicates sending the IR code appropriate for the current IR code set to set the channel of the tuner to the Test Channel.

"SEND CHANNEL UP" indicates sending the IR code appropriate for the current IR code set to increment the channel of the tuner by one.

"CHANNEL UP WORKS" indicates that, while the IR code set is not the correct IR code set for this tuner, the Channel Up command will cause the tuner to increment the channel.

"CHANNEL UP DOES NOT WORK" indicates that the Channel Up command has no effect upon the tuner.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/12261

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :H04N 5/44
US CL :348/10, 734
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 348/6-12, 734; 455/6.1, 6.2; 386/46, 96

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,365,282 A (LEVINE) 15 NOVEMBER 1994, FIGURES 1-3	1-4 AND 9-12
A	US 5,373,330 A (LEVINE) 13 DECEMBER 1994, FIGURES 1 AND 2.	1-4 AND 9-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
22 OCTOBER 1997	12 NOV 1997

Name and mailing address of the ISA/US	Authorized officer
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Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/12261

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 5-8 AND 13-16
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.